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METHODS FOR INCREASING THE ACCURACY OF MEASUREMENTS

Аннотация*: в этой статье рассматриваются вопросы повышения точности измерения, появления ошибок и их устранение. Приводятся некоторые из наиболее точных типов измерений для расчета ошибок.*

Ключевые слова*: измерение, ошибка, методы.*

Abstract*: in this article, the questions of increasing the accuracy in the measurement are examined. The appearance of errors and elimination of them. A few of the most accurate types of measurement to pay off errors are given.*

Keywords*: measurement, error, methods.*

Analysis of the causes of measurement errors, the choice of methods for their detection and reduction are the main stages of the measurement process. Errors in measurement can be divided into systematic and random. In the process of systematic and random measurement errors occur together and form a non-stationary random process. Division errors on the systematic and random are a convenient technique for the analysis and development of methods to reduce their impact on the measurement result [2].

Consider methods of detection and elimination of systematic errors, because they depend on the choice of measurement method and its implementation.

By the nature of changes in the systematic errors are divided into:

1. Permanent – errors associated with incorrect grading of the scale, deviation measures the size of the nominal value, inaccurate choice of models of objects.

2. Variables o periodic – error varies according to the periodic law, such as the error count in determining the time on the clock tower, when viewed on the arrow below, the temperature accuracy of the temperature changes during the day, etc.

3. Progressive – error monotonically changing (increases or decreases) in the general case on the complex, usually unknown to the law. Progressive errors in many cases due to the aging of components of measuring instruments, and can be adjusted in its periodic verification [2; 3].

Due to the occurrence of measurement errors are divided into three main groups:

1. Methodical – error due to the inadequacy of models of real objects, imperfect measurement methods, simplification of dependencies underlying the measurement uncertainty of the measurement object.

2. Instrumental – error caused primarily features used in media measurement principles and measurement methods, as well as the schematic, design and technological imperfection of measuring instruments.

3. Interaction – due to the mutual influence of the measuring instrument, the object of study and the experimenter. Errors due to the mutual influence of money and measurement object is usually taken to refer to methodological errors, and the errors associated with the actions of the experimenter, called personal errors. However, such a classification is not sufficiently reflecting the essence of the errors.

4. Identify and remove the causes of errors – the most common method of reducing all kinds of systematic errors. Examples of this method are: temperature control of individual units or a device as a whole, as well as measurements in thermostat indoors to avoid temperature error, the use of screens, filters and special chains (e.g. equipotent circuits) to eliminate errors due to the influence of electromagnetic fields, interference and leakage currents, and the use of stabilized power sources [2; 3].

To reduce the error due to the progressive aging of the components of measuring instruments, the parameters of such elements is stabilized by artificial and natural aging. In addition, systematic errors can be reduced by rational arrangement of measuring instruments in relation to each other, a source of influence and impacts to the object of study. For example coil instrument must be removed from each other, the axis of the

coils should be arranged at an angle of 90g. Thermocouple conclusions should be placed on the isothermal lines of the object [2; 3].

Many systematic errors that are not time varying values affecting functions or stable due to physical effects can be theoretically calculated and introducing corrections or eliminated using special correcting circuits. Another radical way to eliminate systematic errors is the verification of measuring instruments in the operating conditions for the purpose of determining the amendments to the measurement results [2; 3].

This makes it possible to take into account all systematic errors without finding out the cause. The extent of the correction of systematic errors in this case, of course, depends on the metrological characteristics of the standard instruments used and random errors of verified devices [2; 3].

In fact, calibration of measuring instruments before using them, and the introduction of adequate use of measuring instruments amendments higher accuracy classes, provided that the random error of measurement means are small compared to the systemic and systematic errors themselves slowly change over time [4].

Inversion method is widely used to address a number of standing and slowly varying systematic errors. This method and the number of its species (method exception error on a sign, switching inversion, structural modulation, two-time measurements of inverting conversion functions, etc.). Are based on the allocation, of the algebraic sum of a fair number, of measuring data signals due to invert different direction informative, signal, a reference signal or a sign error [4].

Modulation method – a method close to the inversion method in which periodic input signal inversion and noise suppression, having unidirectional action [4].

Substitution method (occurring at different comparison method) is the most versatile method, which allows you to eliminate most of the systematic errors. The measurements were carried out in two steps. First, at the reference device make count measured value, and then keeping all the experimental conditions the same, instead of the measured value to the input of the device under a certain value, which value by controlled steps (calibrator) is set so that the instrument reading was the same as in the inclusion of the measured value [4].

The method is a kind of uniform calibration of the replacement method; it is used for measurements of such quantities, which can not be accurately reproduced by means of regulated measures or other technical means. Typically, this value varying with high frequency or complicated law. As a known controlled variables at the same time use the value of the same kind as measured, but they are different from the spectral composition (usually constant in time and space) and to create the same as the measured value, the output converter [4].

The method of the reference signal is that of measuring instruments input periodically instead of the measured value supplied reference signals of the same kind as the measured value. The difference between the actual calibration curve used for correction or sensitivity for the automatic introduction of amendments to the measurement result. In this case, as in the method of substitution, all systematic errors are eliminated, but only at those points of the measuring range, which correspond to reference signals. The method is widely used in modern digital precision instruments and information-measuring systems. An example of using this method is the periodic adjustment of the operating current in the compensator and digital DC voltmeter using a normal element [4].

Test method – using this method the measured value is determined by the results of a number of observations, in which, in one case the input signal measurement means is itself measured value X, and the other – the so-called tests, which are functions of the measured value [4].

The method of measurement used by the subsidiary to avoid errors due to influence quantities and non-informative parameters of the input signal. To implement this method in conjunction with the measured value X using auxiliary measurement devices are measurement values of each of the impact and the computation by a computing device and the formulas and algorithms corrections to the measurement results [4].

Method symmetrical observations are to conduct repeated observations at regular intervals and averaging the results of observations symmetrically arranged relative to the average observation. Usually this method is used to eliminate errors progressing,

changing linearly. For example, when the resistor measured by comparing the voltage on the measured and reference resistors connected in series and fed by a common battery, an error may be due to power discharge [4].

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